Compositional Evolution of Cretaceous Cordilleran Volcanism

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Continental arc volcanism likely exhibits temporal variation in composition and flux, but the timescale and nature of these changes are poorly documented. Composition can affect explosivity, amount of ash and volatiles, and the availability of nutrients such as Fe, Si, and P, thereby influencing volcanic hazards, climate, and biological productivity. We examine a sediment core from the Cretaceous Western Interior Seaway, a distal backarc basin that records nearly 300 distinct eruptions between 90-97 Mya. The combination of the many eruptions and their high-precision, astronomically tuned age model applied by past studies allows us to construct an extraordinarily high temporal resolution record of composition in the Cretaceous Cordillera. As Si is mobile in the intense secondary processes involved in the transformation of ash into bentonite, we must reconstruct SiO_2 from geochemical proxies such as the immobile element ratio Ti/Zr. Our compilations of modern continental arc data from the Andes, Cascades, and Central America show that the relationship between Cordilleran Ti/Zr and SiO_2 is independent from location. Therefore, we can use this relationship to reconstruct ash SiO_2 without knowing the precise source of the ash. We apply our reconstruction procedure to 46 bentonites to show that volcanic composition varied in a cyclic manner over timescales of approximately 1 Myr. As SiO_2 has been linked to crustal thickness, these observations have important implications for changes in the transcrustal magmatic system. While it is unclear whether such changes over 1 Myr timescales are driven by tectonic or magmatic triggers, what is evident is that our approach affords unique perspectives towards understanding these processes driving Cordilleran volcanism.